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PLANTAR NEURALGIA.

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PLANTAR NEURALGIA. (METATARSALGIA — MORTON'S PAINFUL AFFECTION OF THE FOOT.) By
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THIS painful affection has barely received any attention at the hands of English writers, and in no text-book on medicine or surgery can I find any reference to it.¹ It was not until 1876 that Thomas G. Morton, of Philadelphia, first drew attention to what he called "a peculiar affection of the fourth metatarsophalangeal articulation." He gave a complete history of six cases, to which I shall refer later. C. R. Mills gives an account of a case in a lecture on pain in the feet; and Dr Pollosson in 1889 drew attention to the same affection, under the term 'anterior metatarsalgia.' Roughton recorded a case, while Guthrie narrated his own sufferings. Cases have also been recorded by Meade Kemper, Goldthwaite, Mason, Grun, Gross, Agnew, T. S. K. Morton, Roswell Park, Gibney, Bradford, and Woodruff. This about comprises the whole of the literature upon a very important and a far from uncommon lesion, which, in its more severe varieties, is accompanied by very distressing symptoms. The discovery, description, and treatment of the affection have therefore almost entirely to be ascribed to American surgeons.

¹ Since writing the above, I find my friend Mr Tubby has included metatarsalgia in his recent work on Deformities.

The disease may be defined as a painful affection of the plantar digital nerves, increased by pressure, and usually located near the fourth metatarso-phalangeal joint. After a reference to the anatomy of the foot, I will allude to the symptoms more in detail.

The arches of the foot are usually described as two in number,—the longitudinal and the transverse. The longitudinal may be considered to consist of two arches,—an inner and an outer. The inner arch consists of the os calcis, astragalus, scaphoid, three cuneiform bones, and three inner metatarsal bones.

The outer is made up of the os calcis, cuboid, and two outer metatarsal bones.

The transverse arch is formed by the cuboid and the cuneiform bones. The longitudinal arch has its concavity directed downwards, and the transverse downwards and inwards. The two arches, longitudinal and transverse, taken together, make up a semi-dome, as Ellis pointed out, and, as a matter of fact, are not separate structures, but part and parcel of a single structure, *i.e.*, the semi-dome. This semi-dome is open internally, but closed behind, externally, and in front, and has its highest point at the mid-tarsal articulation. The two feet placed together make up a single dome. These arches of the foot are essentially connected with the upright position. The weight of the body coming down the tibia enters the astragalus, the pressure planes of which are directed downwards and backwards, and downwards and forwards. By the downward and backward lamellæ the weight of the body is continued to the ground through the os calcis and the heel, but the forward and downward carry it to the ground by the os calcis, cuboid, and metatarsal bones, all of which show definite pressure lamellæ. Taking the view that the arches are not separate, but merely integral portions of a whole, one is prepared to find that, along with a flattening of the longitudinal arch, the transverse arch is always affected, and *vice versa*. This observation can be proved to be correct by clinical observation. Associated with this must be noticed the relative position of the heads of the meta-

tarsal bones to one another. In a coronal antero-posterior section of a frozen foot, kindly prepared for me by my friend and former colleague Dr A. J. Chalmers, their position was

2nd in front of 1st by $\frac{1}{4}$ inch.

3rd behind 2nd by $\frac{1}{4}$ inch.

4th „ 3rd by $\frac{1}{4}$ inch.

5th „ 4th by $\frac{3}{8}$ inch.

The head of 4th and that of 5th are considerably behind the preceding toe. Furthermore, one should note that the fourth branch of the internal plantar nerve communicates with the superficial division of the external plantar, and divides to supply the adjacent sides of the 3rd and 4th toes. The position of this superficial division (fig. 5) of the external plantar is, in my opinion, of importance in the production of the pressure neuralgia of which this paper treats. In their course towards the toes, the digital nerves, before they divide into the two nerves which will supply the contiguous sides of two adjacent toes, lie between, but not deeply between, the heads of the metatarsal bones. The fourth metatarso-phalangeal generally, but not invariably, is the most commonly affected joint; and Morton, in his original description of its pathology, advances a very plausible, but I venture to think only partially correct, theory of its etiology. He says that the metatarso-phalangeal joints of the first, second, and third toes are found on almost a direct line with each other, while the head of the fourth metatarsal is from one-eighth to one-fourth of an inch behind the head of the third, and the head of the fifth is from three-eighths to half an inch behind the head of the fourth: the joint of the third, therefore, is slightly in advance of the joint of the fourth, and the joint of the fifth is considerably behind the joint of the fourth.

The fifth metatarsal joint is so much posterior to the fourth that the base of first phalanx of the little toe is brought on a line with the head and neck of the fourth metatarsal, the head of the fifth metatarsal being opposed to the neck of the fourth (fig. 1). On account of the character of the peculiar tarsal articulation, there is very slight lateral motion in the first three metatarsal

bones. The fourth has greater mobility, the fifth still more than the fourth, and in this respect resembles the fifth metacarpal. Lateral pressure brings the head of the fifth metatarsal and the phalanx of the little toe into direct contact with the *head and neck of the fourth metatarsal*, and to some extent the extremity of the fifth metatarsal rolls above or under the fourth metatarsal. The mechanism of the affection, Morton asserts, becomes apparent when the nerve supply of the parts is



FIG. 1.—Diagram of frozen section, showing that there is most space between the metatarsals of 4th and 5th.

considered. The branches of the external plantar nerve are fully distributed to the little toe and to the outer side of the fourth: there are also numerous branches of this nerve deeply lodged in between these toes, and they are liable, Morton argues, not only to be unduly compressed, but pinched by a sudden twist of the anterior part of the foot. Any foot movement which may suddenly displace the toes when confined in

a shoe, may, he adds, induce an attack of this neuralgia. Later, I will venture to criticise, in the light of clinical evidence, the theory of causation as advanced by Morton.

Passing from the anatomy to a clinical description, I would describe three varieties :

(a) Plantar Neuralgia of the first degree.

(b) " " second degree.

(c) " " third degree.

(a) In the first class one would comprise those cases where pain is occasionally felt along the metatarso-phalangeal joints during the performance of certain acts, but is immediately recovered from on desisting from such acts. In this stage there is no pain on pressing the spot. This stage is very common, and many readers will recall their own experiences in dancing or riding. It is a very usual complaint of the dancer that he has to rest because of aching behind his toes, and who of us has not met with the horseman anxious to rest his painful foot by riding without stirrups? In occupations where the bodyweight falls on the anterior part of the foot, the affection is frequent, more especially where slippers or thin-soled boots are used.

(b) Those cases where characteristic symptoms quickly follow early attempts at walking after injury, due probably to a painful yielding of the transverse arch.

The following case will represent a type of this variety. A young lady of 24, of weak ligament type, whilst patting a horse after a ride, was trodden upon by its fore-leg. The foot was considerably swollen, not very painful, and no lesion worse than pressure-bruising could be observed. She laid up for a week, and then walked about in house-boots or slippers. In less than three weeks she complained of considerable pain behind the 4th and 5th toes, and frequently had to rest. The pain, however, went, almost immediately on abstaining from walking or standing. This pain lasted two months, and only left her when appropriate mechanical treatment, to be described later, was employed.

(c) The third or severe variety comprises those cases where symptoms appear idiopathically or remotely after injury, are

persistent in character, do not yield to mechanical measures, and to all effect cripple the patient.

I purpose relating seventeen cases in illustration of this most agonising class; and I have endeavoured, where practicable, to allow the patients to describe in their own words the course of their disease.

CASE I.—In 1894 a lady of about 45 was brought to me by my friend Dr Willoughby Gardner, of Shrewsbury. She had consulted a number of our profession, but the ailment was ascribed to rheumatism, gout, or hysteria; and although Dr Gardner had exercised considerable ingenuity in trying to relieve the painful area from pressure by mechanical means, nothing seemed to give her any relief. On examining the foot there was some reddening of the 3rd and 4th toes, and the nail was altered, from malnutrition. There was no swelling. The patient seemed very hopeless and distressed, and had quite given up walking, which was impossible to her. There was distinct pain over the 4th metatarso-phalangeal joint. There were no callosities nor corns. The foot was flat, both arches having yielded. I append her brief description, which somewhat inefficiently describes her plight:—

“It was in the early part of the year 1893 I first began to be troubled with a pain in the third toe of my right foot whenever I wore boots: in loose slippers I felt nothing of it. As time went on the pain increased terribly, and my toe became swollen and discoloured, and the nail almost disappeared, drawn in by intense pain. I consulted several doctors, but they were unable to give me any permanent relief, and for more than two years my life was entirely spoilt by the pain in my foot, which I can only describe as sickening, like treading on something very hot. Since the operation last July I have had no recurrence of the old pain, and lately I have been walking several miles almost daily.”

The operation will be referred to later.

CASE II. was that of Mrs S., age 24 (?), upon whom I operated with Dr Macfie Campbell. Her life, which was an active one, was rendered utterly miserable, as she could

neither walk, hunt, nor dance. Her right foot was flat, with a yielding of the anterior arch. There was no swelling, nor any history of rheumatism or gout. Pressure on the 1st, 2nd, 3rd, and 5th metatarso-phalangeal joints was painless, but the moment the 4th was squeezed there was considerable pain. She complained of a subluxation, and certainly the joint appeared to be abnormally lax, but I could not by manipulation dislocate it. There was no redness nor sign of malnutrition. She describes her case as follows:—

“The first complaint I had to make of my foot was in January 1893, when, on walking any distance, a sort of cramp up my instep occurred, which, on continuing to walk, increased up to my knee, and in several instances to my hip. Sometimes, however, I did not feel it, but it was very seldom. The pain described continued, until I was able to walk less and less. The warning always came in a sort of pain under the pad of the foot, as if walking on a hot marble, and then I became so lame and it so painful that I was obliged to stand still, wherever I was, and hold my foot off the ground until the pain subsided. The early part of this year, 1895, it became so much worse that I had to remove my shoe or hop to some cab, as there was no chance of getting the shoe on again because of swelling; and I was unable, as before, to press the foot across the instep, to get the toe back in what seemed the proper place; and often I heard it click back, and then the pain passed off for a time, but lately this did not act; hours often passed and I was in pain with it. I decided, therefore, to consult you about it, and did so. It was operated upon, and now I can walk with perfect ease, and have never since experienced that feeling of a small bone out of place. I can in no way account for the origin of the affection, and have never hurt the foot in any way to my knowledge. However, I am very pleased with the operation, and think it a great success.”

The following is an extract from a letter written by Dr Macfie Campbell four months after the operation:—

2nd November 1895.—“I have seen Mrs S. this week. She walks very well, and never spoke of her foot: a good sign.”

CASE III.—Miss C., a young lady of about 22, came from Ennis, Co. Clare. She thus described her case:—

“On the 26th December 1892 I first felt pain in my foot, and went to a dance that evening. As it was at a house near, I walked to it, but did not feel any pain until beginning to dance, when I experienced a sudden sharp pain in the sole. However, I did not give in to it, but went on dancing, and by the end of the evening it was extremely painful. Next morning the foot was very much swollen, and so painful that it could not be put to the ground without great difficulty. Showing it to a doctor, who examined it carefully, he said that he could not ‘localise’ the pain, but that I had better lie on the sofa for that day. The pain and swelling continued for just over a week; after that I could get into a very loose boot and walk a little, but not without pain, and in less than a fortnight I went out skating. There was no pain whilst skating, but directly I took off the skates and tried to walk it came on again. By degrees it got better, but for about a month I could not dance without feeling it, and on taking a long walk or standing about much I felt it painful and swollen. After that it got quite well until the summer of 1893, when, after playing tennis, it came on again, and then I painted it with iodine, which seemed to reduce the swelling, but it always felt worse in hot weather than in cold. It did not trouble me again until the following summer (1894), when I found that I had to get my right boot made wider than the left. In September 1894 I went to Weymouth (where it first became painful), and there walked a great deal. It is a very hilly place; and after being there about a fortnight I began to feel the pain again, and in the evenings the foot was so swollen and hot that I could hardly put on my shoe. It went on like this, getting gradually worse (though there were some days on which I did not feel any pain), until about March of this year, when it got so bad that I almost gave up walking altogether, and it was particularly painful in damp weather. Then I tried what complete rest would do; for six weeks I did not walk more than a couple of hundred yards a day, and had the foot shampooed three times a week with very

hot water ; it then felt better, but directly I tried to walk again, the redness, swelling, and pain came on."

This lady had a flat foot, broad at the base of the toes. The 4th and 5th toes were reddish, and slightly purple at the tips, and the foot generally was cold. There was some swelling, but no heat. There was no evidence of hysteria, rheumatism, or gout. There was slight pain on pressure over the 3rd articulation, but very considerable pain on pressure over the 4th.

This case gave me more trouble than any on the list, as, owing to an indiscretion in the matter of walking after operation before the wound healed, its progress was retarded. There has also been some slight pain over the 3rd toe, but not sufficient to justify operative proceedings. The original trouble has, however, quite subsided ; and when I met Miss C. in Dublin she was on her feet all day, at the Leopardstown Races and the Dublin Horse Show.

CASE IV. is an instance of traumatic origin, leading to the third variety of metatarsalgia. She was a woman of 50, of neither gouty nor neurotic temperament, but who had some years previously suffered from subacute rheumatism. For a considerable time she had not walked more than fifty yards at a time without experiencing agonising pain. She says :—

"In April of 1884, while pottering in the garden, I sprained my foot, but took no notice of it, and continued with my work. For a few days it was painful and swollen, and ached a little at night-time, but in two or three weeks recovered. I noticed, however, that for a few months my foot appeared to be weak, and occasionally the instep appeared swollen and felt full. For this reason I used to apply a bandage round the instep, which always seemed to give my foot strength. For two years, off and on, the instep pained me, and it had not quite recovered when in 1886 I fell down two or three stairs and again sprained my ankle. This time I remained for three or four weeks in bed, and my foot was encased in plaster of Paris. From that time to this (1895) I have never been free from pain on walking, but it was only in 1892 that it became so agonising as to make my life a burden to me. From that date until this I have not been able

to walk beyond a few yards without the greatest pain. At that time I travelled from London to Edinburgh, and started to do some shopping the following morning. After walking with my usual discomfort for about ten minutes the pain in my foot became almost sickening, and I went into a shop to sit down. On pulling the boot off, squeezing the foot, and grasping the instep, the relief was very marked. I then tied a braid bandage tightly across and replaced my boot. I had not gone a hundred yards before the pain again seized me, and it seemed as if all the nerves in my body were being drawn out of the sole of my foot. I walked a few yards on my heel, but could obtain no relief, so took a cab to the hotel. That evening any movement of my toes gave pain, and I awoke next day only to spend a more excruciating martyrdom than before. Five or six times the paroxysms came, only to be relieved by the removal of the boot and by squeezing the foot. I returned to London, and for a month remained under treatment. I consulted a surgeon, who recommended me to a physician, who treated me for rheumatic gout. Meanwhile, whenever I walked the pain came on. For twelve months I remained more or less a cripple, never deriving any benefit from any of the seven or eight medical men whom I consulted. The foot used to swell a little, sometimes it would redden over the instep, and the pain often shot up into the muscles below the knee. Sitting long in one position, getting in and out of my bath, treading on a pebble—any of these invariably induced a spasm. In short, from 1892 to the end of 1895, I would willingly have allowed my foot to be amputated."

This patient made a complete recovery after excision of the 4th metatarsal head. It was a typical case of plantar neuralgia, with flat-foot longitudinal and transverse, and great pain on pinching the metatarso-phalangeal. There were no nutritive changes in the toe.

CASE V.—M. C. F., aged 42.

History.—About three years ago, she noticed that on certain days she could not walk a distance without a sense of fulness of foot. It was always a relief when the boot was removed. The pain was localised as having been more marked over the scaphoid

and also over the front of the foot. The relief was immediate on the removal of boot and of pressure. Some days there was no pain, even after long-distance walking. About two years ago she suffered an attack of subacute rheumatism, affecting mainly left ankle and right knee. The ankle was much swollen. The worst temperature was 102° , and she remained in bed for a week. On recovery, the foot lost considerably in strength, and became hot and painful in walking, and this occurred always. The pain was mainly over the front of the foot, and sometimes the toes became cramped. The boot had to be taken off frequently in the day, and sometimes the throbbing and pain continued until the foot was plunged into hot water. No particular action on the part of the patient in the matter of flexing toes or manipulating them seemed to affect the issue. Towards the early part of the year the discomfort produced depression, and loss of sleep and appetite. Patient was removed to the infirmary, where local remedies were applied. Among these figured iodine, lead and opium, strapping and cauterization. During recumbency there was no pain. On commencing to walk again the pain became more pronounced than ever, and plaster of Paris was applied, and often renewed. Another trial was made in walking, but without good result. On examining patient, there was extreme flat-foot of a static kind, pain on pressure over scaphoid, and where the external malleolus impinged on the os calcis. The pain was acute on pinching the third and fourth metatarsophalangeal joints. Operation: excision of heads of 3rd and 4th. Patient in bed for three weeks. In eight weeks announced herself as being free from pain, and has continued so for several months.

There was no flat-foot on right side.

CASE VI.—A. E., commercial traveller, aged 29. Four years' history of plantar neuralgia. Last two years, symptoms of lesion pronounced.

- (a) Pain over front of foot.
- (b) Pain relieved by squeezing base of toes.
- (c) Easier on removing boot and flexing toes.
- (d) Often redness over toes.
- (e) Swelling rarely.

On examining, pain over 4th, very slight over 2nd and 3rd. Flat-foot: no swelling.

Excised 4th. Bed three weeks.

Wrote to his doctor:—"Am doing my eight miles a day without discomfort; have never looked back since Mr Jones operated."

CASE VII.—Hallux valgus—plantar neuralgia—excision of 1st joint—rectification of deformity—disappearance of all symptoms.

Miss F., governess, aged 22. Five years suffered with hallux valgus and bunion. Considerable pain locally, but also flat-footed. Complained of much pain over base of toes. Boot had often to be removed. She was not able to walk far, latterly. Obligated to sit down at school all through tuition. Extreme pain on pressing over 4th metatarsal and 2nd. After removal of joint of big toe, symptoms quite relieved. Metatarsalgia gone.

This is most interesting, as showing the disappearance of a metatarsalgia in curing a hallux valgus. The recovery is no doubt due to the fact that more freedom of movement was allowed to the toes, by the removal of obstruction to flexion.

CASE VIII.—Jane H. No good history to be obtained. Could not walk without pain for the last two years—sometimes the pain came on even when slippers were used. Very gouty family history. Both feet flat and both affected. Often had to walk on heels all day. No swelling or discoloration. Pain over 4th metatarsals on pressure. Excision of heads in both feet. Complete freedom from discomfort in two months after operation. Can stand all day in tobacconist shop, with but slight pain, which is easily endured if patient walks a great deal.

CASE IX.—K. J., aged 41. Three years *bad*, but felt it for seven or eight. Had to leave business because of acute pain. Feet flat—pain localised over base of toes. Eased by tying firm bandage round foot. Other symptoms similar to vii. (Miss F.). Completely cured on removal of 3rd and 4th.

CASE X.—J. H., sailor, æt. 34. Operated June 1893. Sprained right foot two years previously by catching foot under a loose plank on board "Teutonic." Pain constant, but sometimes

very acute. Always easier in slippers. No pain at night-time. Pain lancinating and throbbing in character. Foot never swollen. For four months has not walked more than a few yards at a time. Toes often swollen and red after walking. Sometimes has considerable aching on inner side of leg, over the site of tibial muscle. Handkerchief tied over base of toes gives relief. On examining, no swelling was found. The arches of the foot were much flattened: there was considerable pain over bases of 3rd and 4th metatarso-phalangeal joints on pressure, which could not be so accurately localised in the absence of pressure. No movements of the foot by manipulation gave rise to pain. Circulation of foot good. Excised 3rd and 4th joints. Patient walked $1\frac{1}{2}$ miles at the end of the month. Seen in January, free from pain.

CASE XI.—K. L., baker's assistant, aged 27. Pain very severe for fully eight months before operation (August 1895). Pain localised by patient over head of 4th metatarso-phalangeal joint. No enlargements to be made out. Off and on his club for last three months. Given two doctors' certificates that he was able to follow his employment. Massaged and electrified by electrician without relief. Pain localised on pressure over 4th metatarso-phalangeal articulation. Removed base of phalanx and head of metatarsal. At work in six weeks.

With the exception of severe cramps every now and again, which only last a few seconds, patient does not complain.

CASE XII.—F. J., aged 21. Fractured his 3rd and 4th metatarsal bones, near their heads, in February 1894. Injured by the fall of a safe, which was being moved from one room to another. Fracture not compound. Treated for three weeks, and then went about work in plaster support: considerable brawny swelling, which lasted several months, with some blue discoloration. Foot never easy for twelve months before operation. Described pain as being of a burning character. Very little affected by weather. No manipulation eased it. Often took boot off and bathed in hot water for an hour at a time. Off duty for two months. Foot sometimes became swollen over toes, but not always, even when there was pain.

Often spent a day walking on heel, when walking was necessary.

On examination, August 1895, considerable deformity, due to callus exudation at upper part of 3rd and 4th metatarsals. Not painful, excepting on firm pressure. No pain over 4th metatarso-phalangeal articulation. No flat-foot. Some blueness of 4th toe, and often numbness.

Removed head of metatarsal of 4th, including callosities. Left callosity on 3rd. Operation quite successful so far as pain, but foot yet remains weak, and easily tires.

CASE XIII.—K. F., aged 19 (Dr Adam). Complained of constricted feeling over left foot, with occasional severe paroxysms over toes and front of foot. Remembered spraining it at tennis twelve months previously. Had been treated for flat-foot for two years, which was not of a painful character. She was a school-teacher, and for the last eight months could only get to school by taking an omnibus, and then hopping for a couple of hundred yards to the school. Her foot sometimes swelled, but was always relieved when the boot was removed, and the base of the toes pressed laterally in the direction of restoring the arch. It was easier, however, in tight than slack boots. She described pain as being of a sickening character, and so great that she often burst out crying, and had become quite depressed. She often, for relief, would walk on the inner side of the foot, but this only gave temporary respite. She sometimes had to sit on a doorstep, and often called in at shops to relieve herself of the boot. No treatment gave relief. Consulted in September. Strong muscular physique. Had arrived in considerable pain. Examined her foot, which was flat, without swelling or discoloration. A little pain over all met. phal. artic., worst over 4th.

Operated, and removed head of bone. Wound healed in four days. Walked with protected boot in a fortnight. Wrote three months after: "move as if in a dream, scarcely believing the sufferings I have gone through."

CASE XIV.—J. W., aged 37 (Dr McDougall), for three years (1893 to 1895) in great difficulty when walking. No history

of injury. Had casts of foot, changed bootmakers, consulted surgeons and physicians, and, beyond treatment for tarsal arch, nothing was done. Boots moderately tight at sides of toes, and well fitting over instep, answered best. Often could not walk more than 500 yards without great pain. Relief always on removing boots. No history of gout or rheumatism. No swelling or discoloration. Pain on pressure over 4th, and slightly over 3rd and 2nd. Removed 4th. Managed to walk in three weeks, and is now recovered. Sometimes an aching in the calf, over site of *tibialis posticus*.

CASE XV.—Mrs W. (Dr Robinson), aged 50. Subject to gout. Sprained ankle in May 1893. In August complained of inability to walk distances without experiencing a pain which, starting quietly, gradually became unbearable. This disability grew, until at length she was unable to travel more than 300 or 400 yards. Has gouty attacks in consequence, more frequent and severe. Towards middle of 1895 pain became very intense. Obligated often to remove boot. No redness, but often swelling over the front of the foot. Squeezing instep and rapidly moving the toes gave most relief. No medical measures availed.

On examination, foot flat; toes drawn up considerably, as in hammertoe. No abnormality of circulation or innervation. Pain on pressure over 2nd, 3rd, and 4th metatarsal. Removed, in July, 3rd and 4th. Symptoms considerably relieved during first two months, and now patient can walk two or three miles without discomfort.

CASE XVI.—Fibroma of plantar fascia, giving rise to symptoms of metatarsalgia.

Miss B., aged 26. Complained of great pain over toes, which often involved removal of boot and limited walking. Sometimes pain was acute. There was no history of injury. Foot not flat. Pain and partial disability had occurred for twelve months. In character, very like metatarsalgia. Pain sometimes paroxysmal, often relieved by lateral pressure. Fibroma found on foot.

This appears to me to be a very interesting example of the painful effect of pressure, simulating accurately, as it does, the

commoner variety of Morton's foot. There was no flat-foot, and removal of the growth was quite effective.

CASE XVII.—Mr S. writes from Windermere:—

“In the spring of 1887, when fishing with a heavy pair of boots on, I suddenly felt a very sharp pain in my right foot. I walked home with difficulty, and could never subsequently do any walking with heavy boots on. So long as I did not wear heavy boots I felt no further inconvenience until about 1890, when my foot began to pain me if I walked more than about a couple of miles, and it gradually got worse and worse. About 1893 I found I could walk any distance only by wearing boots with very narrow toes, and until operated upon I continued to wear very tight boots, causing bad corns and general discomfort, but relieving me of the pain in question. During the last two years or so I have been unable to move freely about the house, with the most easy carpet-slippers on. When the pain came on it was most acute, and made walking impossible. I could obtain relief only by taking the boot off and compressing the foot in my hand for a few minutes. Under the advice of various and many general practitioners and surgeons I tried ointments, plasters, meehancial fixtures on boots, etc. etc., all without obtaining the least relief. There was never at any time anything visibly wrong.”

This gentleman, of about 33 years of age, was recommended to me by Dr Clegg of Windermere and Dr Heath of Southport. He was very doubtful that anything could be done for him, and felt disinclined to be subjected to experiment. His foot gave him a very distressing time, and quite incapacitated him from out-door amusements.

His foot was very flat, and the anterior arch broadened immediately when brought to the ground. There was no swelling nor redness, and the pain on pressure was localised to the 4th articulation. A tracing of the sole gave no information. After operation the patient made a rapid recovery, and is now quite free from symptoms.

Symptoms.—From an analysis of the foregoing cases, one is enabled to formulate certain symptoms as constant, others as

common, and some as exceptional. In all the cases a complaint was made of pain on walking. This pain was different in character to that of the so-called painful spasm of flat-foot, inasmuch as the pain in metatarsalgia is, in its intense area, strictly localised, while it is generally much more severe and paroxysmal. The painful flat-foot is oftenest found in the cold and bluish foot, while Morton's disease appears to be associated with healthy nutrition. In the milder varieties, pressure has to be continued for a time before pain is manifest; in the severe cases, less pressure produces much greater pain. In the first and second varieties the pain is neither so acute nor spasmodic as in the third. In all my cases there was pain on pressing either on the 2nd, 3rd, or 4th metatarso-phalangeals, and in the majority of cases opposite the 4th alone was the painful spot. This painful spot was in all cases best displayed by pinching the articulation between the finger and thumb. This could be effectively done without interfering with any of the other metatarsals, and is suggestive that Morton's explanation of the anatomy is not the whole truth. If, as my cases tend to prove, the condition is usually accompanied by a broadened foot, due to a collapsing anterior arch during the act of walking, there would be separation rather than an approximation of the metatarsal heads. Furthermore, if Morton's grinding theory is to explain all, why should a localised pinching applied to the metatarso-phalangeal alone give rise to pain. The accompanying radiograph (fig. 2) (taken by Dr Holland) of a case of Dr Hugh R. Jones, upon whom I operated a few days ago for metatarsalgia, exhibits the broken line of metatarso-phalangeals, with the 4th as chief offender; but, even making all allowances for the position of this articulation, it is not easy to conceive of a pure nipping of nerve as taking place where there is so much interspace as the plate portrays. Taking into consideration also the fact that in 13 of my cases grasping the front part of the foot in the hand gave relief, it is not in accordance with the theory of lateral pressure advanced by Morton, as such manipulation should increase, and not decrease, the paroxysm. The explanation of the pain, having regard to the free mobility of the 4th

and 5th, is much more probably a stretching or pressing upon, rather than a nipping of nerve, and would accord more harmoniously with (*a*) yielding of the anterior arch; (*b*) ease experienced by circular compression; (*c*) pain on local pressure. It is a theory which better accords with the exceptional instances of pain over the 2nd and 3rd joints. The mobility



FIG. 2.—Radiograph of foot suffering from Plantar Neuralgia.

of the 4th and 5th allows of greater stretching when the transverse arch yields, and hence the frequency with which these joints initiate the trouble. Furthermore, most pressure in standing is placed upon the 1st and 4th metatarsal heads (fig. 3), whilst the frequency with which relief was obtained by frequently flexing the toes, which involves a lifting of the metatarsals, confirms one's belief that nerve pressure is the

correct explanation of the lesion. In 13 of the 17 cases there was flattening of both arches. This suggests a weak ligamentous structure, and a stretching of the soft tissues of the waist of foot. In 13 out of 17 cases circular compression below the instep gave relief. By this means, doubtless, the arch would be restored and the tissues of the sole relaxed. In the 7 cases where a click in the joint gave a marked measure of relief, I suspected—confirmed by lax ligaments—some subluxation, but in only one case could I produce the click by manipulation. That some neuritis is present in the severe varieties is suggested by the acute



FIG. 3.—Transverse section of foot behind metatarso-phalangeal joints, showing how pressure is borne by 1st and 4th.

character of the pain, and by the statement volunteered by many that it felt like treading on something hot, and by the change sometimes noted in the nutrition of the toe.¹ Particularly suggestive is the practice, during all stages of the affection, of rapidly flexing the toes; an act which cannot be performed without elevating the metatarsals, and relaxing the digital nerves from pressure and stretching. Having related fully the histories of several cases, I will not occupy space by repetition; but I desire to place in order of frequency, symptoms which my own cases have exhibited.

(a) Pain over metatarso-phalangeal region on standing or walking, only slightly relieved by mechanical contrivances.

¹ In conversation with Mr Tubby, he tells me he has just operated on a case of advanced metatarsalgia, and he found the nerve swollen and congested. This confirms the conclusion I have arrived at on clinical grounds.

(b) Pain on pinching the 4th metatarso-phalangeal.

(c) Relief of pain on circumferential pressure around base of toes, assisted still further by repeatedly flexing the toes.

(d) Sensation of walking on something hot.

(e) Presence generally of flattened arches of the foot.

In nearly all the cases reported, prolonged treatment elsewhere had been adopted; and the complaint was generally ascribed to gout, rheumatism, or hysteria. We know how stretched or otherwise injured structures will tempt a visit from any of the three diatheses; but, apart from this possibility, there was no evidence of its existence in the great majority of my cases. In not one case was there any symptom of hysteria.

From an analysis of symptoms in these 17 cases it will be noted:—

That there was a history of injury in 10 cases.

That the 3rd joint was affected as well as 4th in 3 cases.

That lateral pressure gave relief in 14.

That reference was made to subluxation or reduction with click in 7.

That there was flattening of both long. and trans. arches in 12.

That 10 patients were women, 7 men.

That 3 described sensation as if standing on something hot.

That the ages ranged from 24 to 58,—10 being between 30 and 40.

That in one case symptoms were induced by pressure of callosities due to fracture.

That in one case symptoms were induced by small fibroma of plantar fascia.

That symptoms of gout, rheumatism, or hysteria were only found in 2 cases.

That flexion of toes in the majority of cases was productive of relief.

Thomas S. K. Morton, in an excellent article on metatarsalgia, contributes six cases, which are well worthy of perusal. He also presents a few cases as published by Thomas G. Morton, who first wrote on metatarsalgia. The cases so

graphically represent the affection that I make no apology for publishing them in full.

CASE I.—“Miss I. F. S., aged 31 years, teacher, was brought to me by her physician, Dr George L. Romine, of Lambertville, N.J., in June 1892.

“The following history was elicited:—Family history excellent; she has always enjoyed the best of health and strength until the present trouble commenced. In July 1890 she played lawn tennis for the greater portion of a day, coming down heavily on the balls of the feet many times, after which she walked a short distance to her home, and felt greatly fatigued. After resting two hours she attempted to walk, and experienced a ‘queer sensation’ along outside of the left foot, a feeling ‘as if something had given way about half way between the toes and heel.’

“‘In the evening I walked down town, but could scarcely return, for it was so hard to make my foot go. I felt as if retarded in some mysterious way. By the time I reached home a line of pain extended from the place above mentioned all the way to hip. Thinking I had sprained my foot, I applied the usual remedies. The next morning my foot felt rested, but during a short walk on the street the pain in my foot and limb returned.

“‘By this time the foot began to swell, particularly along the outside, and in a few days had a reddish appearance. After a night’s rest the swelling disappeared, and I was able to use my foot, with intervals of rest, in ordinary walking about the house. Each day it gave out after less use, so at the end of five days I called in our family physician, Dr Romine, of Lambertville.’

“It was presumed that a ligament or tendon had been ruptured, and fixation by bandages resorted to. On August 7th these dressings were removed.

“‘The foot and limb were helpless, and the whole side of the foot felt so indescribably bad that it made me faint. A starched dressing was then put on the foot and limb to the knee. For four or five days following I held my foot on a chair, but after that, during part of the day, on a pillow on the floor. Toward

evening I had almost unbearable tingling in the foot, but this passed away on retiring. I never could rest my foot on the outside, from the time of the accident, without having that unbearable feeling in the foot, and at times the line of pain in the limb.

“ ‘ At the end of four weeks the doctor told me to stand with my feet even. Never shall I forget what I suffered that day. The limb had shortened so that the heel was about two inches from the floor, and in trying to stretch it down the bottom of the foot pained and tingled dreadfully. I was completely exhausted and deathly sick.

“ ‘ Crutches were then ordered, and I commenced my hard work of learning to walk.

“ ‘ My foot was so bad on the side, and a line of dreadful pain extended from about two inches from the fourth toe along the side of the foot and to the knee. After a time the pain in the limb seemed better, but the whole side of the foot felt unspeakably bad. The uncomfortable sensation did not seem confined to any particular place on the side, as it did at first.

“ ‘ The 1st of October, the physician advised my going to school, in order to overcome my nervousness, and take my mind from the foot. I wore a worsted slipper.

“ ‘ The last of October, the doctor commenced the use of a battery every night, the interrupted current being used. The sponge was applied under and over the toes five minutes, five on each side of the heel and five under the knee. The toes twitched a great deal, and I always dreaded when the sponge neared the fourth and fifth toes, for I felt the sting and jerk along the injured side, and it made me sick. I could bear only a light pressure there. When applied under the knee I felt the line of pain down the outside of the limb, and often the toes would jump. When the current passed down the inside of the limb it felt agreeable.

“ ‘ My foot always felt badly on removing the shoe at night, and the limb above was very much swollen and glossy in appearance.

“ ‘ The last of July 1891, I took a short walk, without support,

along the piazza. That night my foot pained up to the knee, and I was unable to touch it to the floor for more than a week. I was careful to take only a few steps at a time after that. At the end of a year this was all I could do.

“‘If I rubbed the foot, or put it down otherwise than just flat when I stepped, I was unable to use it afterward.

“‘I used crutches all the time at school, so as not to overtire my foot again; but, in spite of all my care, I had that dreadful feeling on the side, and many days the line of pain up the limb.

“‘Often the foot had fits of shaking, which I could not control.’

“She continued thus helpless, using crutches for locomotion, and became thoroughly neurasthenic, until June 1892, when I saw her in consultation with Dr Romine. We agreed that the diagnosis was clearly the peculiar painful affection of the fourth metatarso-phalangeal articulation, and that the other symptoms were probably but those of reflex neuroses; also that excision of the joint offered the only means of relief. However, it was determined first to try the effect of an ointment composed of ichthyol and lanoline, together with fly-blisters in the course of the affected nerves. These measures proving of no avail, in July I removed the joint. At the same time it was thought best to divide the tendo Achillis, as the heel had become much drawn up by contraction of the calf muscles, and did not relax even under anaesthesia.

“From the moment of operation she never again experienced the old pain, and immediately began to gain flesh and strength under massage, hyper-nutrition, and rest in bed for three weeks. At the expiration of this period she was walking about unaided, and soon was as well and strong as ever. Union by first intention was secured, no weakness of the calf resulted, and the amount of retraction of the toe is about $\frac{1}{4}$ of an inch. She now wears an ordinary shoe, and can make almost any exertion without discomfort.”

CASE II.—“N. C., aged 32 years, female servant, native of Ireland. Family history negative. Had always enjoyed good health until October 1889, when she tripped in going

downstairs, and brought her left foot down violently in saving herself. Instantly she experienced an intense cutting pain in the region of the base of the fourth toe. The dorsum of the foot became black and blue, while the whole limb was affected with a dull, burning pain. For several days she wore a slipper; then the discoloration gradually disappeared, and pain became more endurable. But she had to cut every shoe that was worn, to prevent pressure upon the painful area. This painful sensation gradually extended from the original location up the front of the tibia, and became very severe in that situation. This misled a prominent surgeon to diagnose periostitis of the tibia, and cut down upon and scrape the bone. She remained in the hospital eight weeks, and was discharged unimproved. In February 1891 another hospital surgeon cut down upon and chiselled away a portion of the tibia. Again no improvement followed.

“Early in 1892 the patient entered the Polyclinic Hospital, willing to submit to anything to obtain relief. At this time she was almost helpless, exceedingly neurasthenic, and had lost much flesh. The scars of the previous operations were very evident. The entire leg was blue and cold and somewhat atrophied, but beyond this nothing was evident, except that the fourth metatarso-phalangeal joint and its surroundings were exquisitely sensitive to motion or pressure. From the point, the pain was reflected up through the entire sciatic distribution. She was put to bed, and upon a milk diet for four weeks, while local counter-irritants and absorbents were applied, all to but little effect; the old pains and her general nervous condition persisted. I then excised the affected joint, and was amazed at her rapid progress to subsequent cure. Primary union was secured, and in three weeks she was walking about and entirely free from pain. Since then she has entirely recovered her former health and strength.”

CASE III.—“Mrs E., aged 35 years, well-to-do farmer’s wife, seen in consultation with Dr George L. Romine. Family history good. She is of a neurotic temperament, and faints easily. During last ten years she has been subject to attacks of

neuralgia affecting the left forearm. Three years ago she was seized with neuralgia affecting the second and third fingers of the left hand. There was tenderness in the metacarpal region, whence pains were reflected up the forearm and arm, producing complete disability of the member. The parts were very painful to the touch, and slightly swollen. This condition persisted for four months, and then gradually disappeared. From this time until June 1892 she remained well, when a marked attack of metatarsal neuralgia affecting the fourth toe supervened. This apparently did not follow an injury. The pain became continuous, and resisted all efforts for its relief, except when she laid down, when it would diminish, or entirely disappear. When I saw her at the end of October she had become bedridden, almost helpless, and exceedingly nervous, but nothing of disease was evident in the foot, except the violent unbearable pain that was invariably produced at the fourth metatarso-phalangeal articulation upon the slightest pressing together or rolling upon each other of the outer metatarsal bones. At this time even the weight of a stocking could not be tolerated upon the foot. The pain extended into the peroneal and sciatic nerves. She had lost fifty pounds in four months. The calf on affected side measured one and a half inches less than its fellow.

"The affected joint was excised, primary union secured, and she steadily regained her usual health. Pain has disappeared, and she can walk with comfort.

"A maternal aunt of Mrs E. injured her foot eight years ago, and suffered in much the same manner as did the niece. She had never been able to secure relief, and to-day is scarcely able to walk across a room without bringing on a severe attack of pain.

"A sister of the patient injured her foot ten years ago, and was then confined to her room for twelve months, because pain developed whenever the member was placed upon the ground. For five years she was unable to walk upon the street, while at the present time she cannot walk far without originating an attack of metatarsalgia, and has to be extremely cautious in walking over uneven surfaces."

CASE IV.—“Mrs S. C., aged forty-five years, a missionary, residing in Japan. She writes:—‘When out walking in the city of Tokio, Japan, in the summer of 1888, and wearing a new pair of high-heeled shoes, I felt first a slight pain, which soon increased to severity, in my right foot, in the region of the fourth metatarso-phalangeal articulation. The pain became so intense that I could walk no further. These paroxysms of pain continued to return with the slightest aggravating cause, the disease gradually becoming worse, so that for two years past, when at home, I have seldom had a shoe on my foot, and was not able to bear the loosest shoe while riding in a carriage, being almost always compelled to remove it after entering. When suffering the most intense pain, it was accompanied with a general nervousness of my whole system. Upon removing my shoe all pain and nervousness soon ceased.’

“I removed the affected joint in May 1892. In three weeks the patient was able to walk about with great freedom in ordinary shoes, and has since remained free from pain.”

CASE V.—“Mrs R. T., aged 32 years. Canadian house-keeper. Has suffered for five years from well-marked metatarso-phalangeal neuralgia, involving fourth toe of left foot. No assignable cause. Attacks have been growing more frequent and severe progressively, until she became almost invalided. Was compelled to remove shoe, regardless of surroundings, instantly upon supervention of the attack.

“In December 1892 I amputated the fourth toe, together with the corresponding metatarsal head. In three weeks she was walking about as well as ever, and has been entirely relieved of all discomfort.”

CASE VI.—“Lizzie T., a Russian: single: aged 22 years: mill hand. This woman works the treadle of a machine with right foot. Two years ago began having pain radiating from fourth toe. The frequency and severity of these attacks—necessitating the removal of shoe—have increased steadily, until she was entirely unable to work, and had difficulty in walking.

“In January 1892 she entered the Polyclinic Hospital, and

my Resident, Dr M. W. White, excised the affected joint, under my supervision. Primary union occurred, and the cure has been complete."

Thomas G. Morton gives the following description of a case, written by a medical friend who had been a sufferer from the more severe form of the disease.

"I have suffered intensely at intervals from this affection for many years, and in all this time have never found medical man or layman who understood what I meant when I complained of it or alluded to it. It has been pronounced by surgeons who have examined my foot to be a subluxation or malformation of the articular surface of the first phalanx of the fourth toe where it articulates with the fourth metatarsal bone, the concavity not being sufficiently concave. This, I have long been convinced, is an error.

"My sensations have convinced me that the pain is caused by pressure upon a nerve, but what pressed upon the nerve I was unable to tell. The immediate necessity of removing the boot, and the relief afforded by manipulating the foot in a manner learned by experience, pointed to a dislocation; but the reduction of the displacement was never sufficiently sudden and marked to confirm the belief that there had been a dislocation.

"Now, after living for more than half a century, practising my profession for over thirty years, and suffering half my life with an affection not understood, and ranked with a disease so trifling as a corn, I find myself enlightened, and the mystery cleared up by your valuable paper on the subject.

"The first paroxysm occurred in my boyhood, and was produced by tight-lacing of skate-straps. On unbuckling the straps, the 'cramp,' as I called it, was at first soon relieved, and thought nothing of; but a continuance of this system of squeezing by tight straps and tight boots, and riding for hours on horseback with the flexors of the leg and foot in violent action and the toes turned in, the attacks became more frequent, more painful, and the abnormal condition of the parts became chronic. These were, in my case, undoubtedly the causes pre-

disposing. The causes determining the accession of a paroxysm are the wearing of a badly-fitting boot, especially if the sole be narrow; a long and fatiguing walk, particularly on a hot day over a hot pavement; a long ride on horseback; a wet boot sticking to the sock; a wet sock sticking to the toes; long-continued flexion of the knee-joint, as in a railroad car, carriage, or lecture-room; treading on an uneven surface, as a cobble-stone pavement; and should the nervous system be depressed from any cause, these exciting causes will act more powerfully.

"The symptoms of an attack in my case are most intense pain, 'cutting to the heart,' sickening, a feeling that it is unendurable, faintness, cold sweat, total incapacity for the time directing the mind or will to any other subject, a horrible increase of torture on the use of the boot-jack; and all this with no redness, no swelling, no abrasion of the skin, no callosity, no visible displacement of bones, at least after removal of the boot.

"The suddenness of the attack is noteworthy: I have been obliged to drop everything and remove my boot, sometimes in company, sometimes in my carriage. I have even been obliged to sit down on the curbstone and remove the boot. I have dismounted from my horse, and sent home for slippers before I could proceed. I have tied my horse to a tree and lain on the ground, unable to ride further.

"I have spoken of a tight boot and of removing the boot, but I have had tight boots which were great favourites, because they would not 'let my toe out of joint.'

"The remedies from which I have obtained relief are removal of the boot and then manipulating the toes—straightening them out. When inconvenient to take off the boot, I have found that grasping the foot tightly around the metatarsal region will answer; and I have sometimes worn a circlet of india-rubber, binding the foot round the instep. Putting on a dry boot and dry stocking is of great benefit, and the boot should be well sprinkled with powdered soap-stone before putting it on. Frequently an attack has been relieved completely without other means than rest and a cup of strong tea."

Thomas S. K. Morton also reports the following cases, as quoted by Thomas G. Morton.

CASE II.—Another medical friend writes:—

“For several years previous to 1864 I had been subject to occasional dislocations of a relaxed joint in the fourth toe of my right foot. They had always occurred in walking, and the symptoms were perfectly distinct: the reduction, which was usually effected without difficulty, by simply ‘working’ the toe, was equally unmistakable.

“In the summer of that year I was climbing a mountain, when the joint became displaced; and as it would speedily have slipped out again if reduced, I allowed it to remain luxated until I had finished the ascent and returned to the base, when the pain was so great as to make it necessary for me to ride home. After several hours of suffering, the joint gradually resumed its normal state.

“Since that time I do not remember that the luxation has ever taken place; but I have had many attacks of neuralgic pain in the part, coming on generally after exercise, but sometimes after sitting in one position, as in my carriage. Often exercise does not reduce it. Heat, as from the pavements or the sand in summer, is a much more frequent cause. It begins gradually, and sometimes wears away in the same manner, but sometimes vanishes suddenly, as if by magic, without the use of any means of relief. The pressure of a boot always aggravates it; but it has attacked me while in bed at night. Diversion of the mind will always allay it, but it sometimes comes on again afterward with far greater severity.

“In 1869, while spending most of the summer at Atlantic City, I suffered more from this trouble than ever before or since. It would then often come on at night, after a day in town; and once or twice the attacks lasted more than twenty-four hours. So great was the annoyance from it that I proposed amputation of the toe to a surgical friend, but he advised me against it. Since then it has been much less troublesome, though I have sometimes had it more or less every day for a month.

“Deep pressure over the metatarso-phalangeal joint is painful,

but does not bring on an attack unless long continued. Cold has given me more effectual relief than any other remedy I have tried."

CASE III.—"In March 1873 I was asked to see Miss H. S., aged 26 years, who, while in Europe, four years before, had injured her right foot by stepping upon a small stone. She said that she had at once experienced intense pain, which was soon followed by slight swelling and redness. From the date of the injury, localised pain in the foot continued, especially while wearing a shoe. The pain was referred to the head of the fourth metatarsal bone. There was constant distress in the part, often of a sickening character. After wearing a shoe, pain came on with great intensity. At such times the shoe had to be instantly removed, the least delay causing a paroxysm of great suffering. The boot or shoe had to be removed so often that a slipper was substituted. A marked lameness was induced by the patient's endeavour to spare the foot in walking. The pain was confined to the joint of the fourth metatarsal bone, with the case of the associated phalanx. Pressure in this region, or rolling the fourth and fifth toes upon each other, caused violent pain, which extended up the limb. It was severe when pressure was made upon the base of the first phalanx of the fourth toe, which could be prominently felt between the third and fifth toes."

CASE IV.—"Dr M. W. Allison, of Hagerstown, Md., called on me in the spring of 1875, seeking relief from neuralgia in his right foot, which had existed for years, and was gradually getting worse, and stated that he was willing and ready to submit even to amputation of the leg. He gave the following history:—

"About six years ago I experienced an unpleasant, painful sensation in my right foot, which possibly originated in a strain. The pain was first observed in the fourth metatarso-phalangeal region. In the course of a fortnight it was followed by most violent pain, which was simply unbearable, and so severe that it terminated in a convulsion. A painful condition of the parts followed, and with the least provocation (wearing a shoe or

boot), sometimes without known cause, paroxysms of intense pain returned at various intervals, lasting from one to forty-eight hours. The pain, with one or two exceptions, has been confined entirely to the section of the foot indicated. My suffering has been beyond all comprehension: very often I have been compelled to jump from my buggy, or stop while walking, remove my boot, which has always been of ample size, apply ligatures to the limb or foot, use hypodermic injections of morphia, frictions, or call upon some one to assist me by standing on the foot. This affliction has been the burden of my life, and this burden has been increased after consulting many eminent medical men, who gave me no satisfaction as to the nature of the disease, nor even suggested a hope of relief. My health otherwise has been uniformly good. I am satisfied the cases you have had are similar to my own, save in the intensity of my sufferings; and I shall gladly submit to the operation you have suggested.’”

CASE V.—“Mrs C. H. K., of this city, a lady 50 years of age, gave me the following history:—

“‘The “queer feeling,” I have been accustomed to call it, which has been in my left foot for thirty years, is a painful condition. The pain is in and about the joint of the fourth toe, with occasional attacks of intense suffering, when the pain extends to the knee; and if my shoe is not instantly removed when the attack comes, the pain reaches the hip. It does not matter whether I wear a large or a small shoe, as I have never worn a tight one, but it seems that the least pressure will produce the same result. Often my sufferings have been exceedingly acute, and come on without any warning. Once I was taken while walking in the street, and the agony was so great that I was compelled to rest on a stoop, remove my shoe, and walk some distance in my stocking alone, the pain running in a straight line to the hip-joint. In September 1868, while at the Academy of Music, I had an unusually severe attack, and, not removing my shoe as quickly as I have done, was obliged to walk to my carriage without the shoe, and suffered intensely for three hours. My eldest sister has been similarly affected still

longer than myself, but in her right foot, same toe and joint. She has several times given up wearing shoes, but the attacks continued.' ”

Dr Meade C. Kemper, of Goshen, relates the following case, but does not refer to the treatment adopted :—

“Some time since, Mr C. S., while walking across a field, twisted his foot and fell. Upon attempting to rise, he found that the foot was so painful he could not stand upon it. He was taken to his house, where the foot was examined. It presented a bruised, *blackened* appearance, as if there had been extravasation of blood, but was not swollen, or if at all, very slightly. No discoloration could be detected. Rest, with the foot well elevated, and the use of anodyne applications, gave entire relief in a few days. A few weeks later he was again affected in an exactly similar manner, the pain being so intense that he involuntarily grasped the foot in his hand and forcibly compressed it. For an instant the pain was agonising, but the compression produced what he called a ‘cracking’ sound, which was followed by instantaneous relief. Since that time he has been similarly affected on several occasions, and always succeeds in getting instant relief by making forcible lateral pressure.”

The following case is related by Dr Erskine Mason, Surgeon to the Roosevelt Hospital, New York, and was operated upon with good effect :—

“Frank P., aged 21, native of South America, fireman by occupation, was admitted into Roosevelt Hospital, January 1877, and gave the following history :—

“Sixteen months ago he fell from his engine, and received a compound fracture of the right femur a short distance above the knee, from which he made a good recovery, though with an ankylosed knee. Six months ago he had the great right toe removed in Chicago for what he called neuralgia, though he states that the surgeon who removed it told him that the joint was diseased. It was removed at the metatarso-phalangeal articulation. Four months ago he began to have pain, similar to that which had previously existed in the great toe, in the

metatarso-phalangeal articulation of the second toe. This pain has increased so that for the past two months it has been so severe when walking or standing that he had to give up work, and entered the hospital, either to have the toe removed, or obtain relief in some other way. The general condition was good. There was no swelling or redness about the toe, but the slightest pressure was sufficient to produce pain, and when walking he bore all his weight upon the heel. All the toes were constantly in a state of great extension, and looked almost as if dislocated forward.

“A variety of treatment having been tried, and having failed, Dr Mason removed the joint by a dorsal incision. He found the toe so extended that a partial luxation might have been said to have taken place. He found nothing abnormal in the articulating surfaces of the bone. The wound was a long time in healing, but the patient fully recovered.”

Edmund Roughton reported the case of a medical man, aged 33, who stated that for eighteen months he suffered from attacks of burning pain in the fore-part of the sole of his left foot. The pain occurred several times in a week, and was generally brought on by prolonged standing, and sometimes by walking long distances. It was so severe as to sometimes cause him to remove his boot, and grasp the sole of his foot with his hand. On examining the foot Mr Roughton found that the transverse arch formed by the heads of the metatarsal bones had sunk, so that a distinct convexity replaced the concavity normally found in this situation. In this case the patient had increased considerably in weight during the period of development of the symptoms, and his transverse metatarsal ligament had presumably been unequal to the increased strain.

Bradford and Lovett, in their work on Orthopedic Surgery, draw attention to Morton's article, and apparently agree absolutely with his description of the affection, its pathology and treatment. They state they have seen several cases, but none where operative procedures were demanded. The cases they have met with are evidently those which I have stated should be included under the second division of plantar neuralgia.

Mr Tubby, in his excellent recent work on Deformities, draws attention to the subject, and reports three cases.

CASE I.—A bank cashier, aged 39, and standing most of the day, consulted Mr Tubby for pain on the outer side of the foot. His father had suffered from gout, but he himself had not at any time had an acute attack. On examination of the right foot Mr Tubby noticed the peculiar inward twist, and the base of the fifth metatarsal bone was prominent, very painful, and with a false bursa over it. He complained also of dull, aching pain about the head of the third metatarsal, but it had never been paroxysmal. The arch of the foot was somewhat lowered, and on examining the sole a corn was found over the head of the third metatarsal bone, which seemed to have dropped away from the others. The boots he had been wearing were narrow in the tread and very pointed. Mr Tubby advised that he should rest the foot entirely for a fortnight, and meanwhile a pair of low-heeled boots should be made, with a valgus pad beneath the instep, and so arranged as to fit tightly across that part, and to leave ample room across the heads of the metatarsal bones in treading. Mr Tubby thought it highly probable that the displacement of the head of the third metatarsal bone arose from the pressure of narrow boots on that part of the transverse arch. "To relieve the pain over the base of the fifth metatarsal bone, I suggested that the leather of the boot should be blocked out over that spot. A month afterwards he expressed himself as much relieved."

CASE II.—A gentleman aged 32 consulted Mr Tubby for paroxysmal pain in the front part of the right foot, which became so severe at times as to entirely prevent him moving about. He played much cricket, and had frequently been struck with the ball on the dorsum of the foot. The boots he was wearing were fashionable, and no doubt contributed to the perpetuation of the pain. The latter was always worse in the evening, and occasionally became agonising in a warm room, and was accompanied by considerable redness and extreme tenderness in the first interspace. Relief was temporarily obtained by removing the boot.

On examination, Mr Tubby noted that the arch of the foot had given, the base of the fifth metatarsal bone was prominent, the anterior part of the foot twisted inwards, and there was depression and enlargement of the head of the second metatarsal bone. Relief was obtained by boots constructed on the same plan as in the previous case. He was also advised to soak the feet in hot water containing a drachm of bicarbonate of soda to the pint, and citrate of potash was given internally. After some weeks the pain lessened and disappeared.

CASE III.—Another patient aged 25 consulted Mr Tubby in July 1895 with reference to pain and difficulty in walking. He could only hobble, on account of the pain, and had tried all sorts of boots. The history of gout was well marked in the family. Pain was complained of in both feet about the head of the third metatarsal bones and over the base of the fifth metatarsals. In the soles of both feet the head of the third metatarsal was very prominent, with a large corn on it, and in the right foot smaller ones were present over the heads of the second and fourth. The arch of the foot was much *increased*, and the toes of both feet were hyper-extended. At times acute attacks of pain, lasting on and off for a fortnight, occurred, and completely laid him up. The inward twist of the foot was well marked. So extreme was the displacement of the head of the third metatarsal bone on the right side that Mr Tubby advised its removal. As the patient objected to this, and was anxious to try other treatment, Mr Tubby advised bathing in hot water every night, and boots closely fitting over the instep and very broad in the tread. In November 1895 Mr Tubby heard that a considerable improvement had occurred.

One notes that in each case Mr Tubby merely obtained relief for his patient from the adoption of these mechanical methods: in one case the history does not extend over a month after the discontinuance of treatment. It is interesting that in two out of the three cases mention is made of corns opposite the painful spot. This is valuable confirmation of the pressure theory which I advanced in contradistinction to Morton's view as to nerve-pinching, and may be added to the cases I have reported,

Table of Seventeen Cases of Plantar Neuralgia operated upon by Mr ROBERT JONES.

No.	Sex.	Age.	Joint Affected.	Side.	Presence of Flat-foot.	Other Abnormal Appearances in Foot.	Treatment.	Result.	Duration.
1	F.	45	4th.	Right.	Flat.	Reddening of 3rd and 4th toes. Malnutrition of nails.	Exeis. of 4th.	Cure.	2 years.
2	F.	24	4th.	Right.	Flat.	...	Exeis. of 4th.	Cure.	2 years.
3	F.	22	3rd, slightly 4th.	Right.	Flat.	Reddening of 4th and 5th toes. Foot cold.	Exeis. of 4th.	Cure.	3 years.
4	F.	50	...	?	...	...	...	Cure.	9 years.
5	F.	42	3rd and 4th.	Left.	Flat.	No flattening of right foot.	Exeis. of 3rd and 4th.	Cure.	4 years.
6	M.	29	2nd and 3rd, slightly 4th.	?	Flat.	...	Exeis. of 4th.	Cure.	2 years.
7	F.	22	2nd and 4th.	?	...	Hallux Valgus.	Exeis of Hallux.	Cure.	3 years.
8	F.	27	4th.	Both.	Flat.	...	Exeis. of r. and l. 4th.	Cure.	2 years.
9	F.	41	...	Left.	Flat.	...	Exeis. of 3rd and 4th.	Cure.	3 years.
10	M.	34	3rd and 4th.	?	Flat.	Toes swollen and red after walking.	Exeis. of 3rd and 4th.	Cure.	2 years.
11	M.	27	4th.	...	...	...	Exeis. of 4th.	Cure.	8 months.
12	M.	21	3rd and 4th.	?	No.	Fraeture of 3rd and 4th mets.—old.	Exeis. of 4th.	Cure.	12 months.
13	F.	19	4th.	Left.	Flat.	...	Exeis. of 4th.	Cure.	12 months.
14	M.	37	2nd and 3rd, slightly 4th.	?	Flat.	...	Exeis. of 4th.	Cure.	3 years.
15	F.	50	2nd, 3rd, and 4th.	?	Flat.	...	Exeis. of 3rd and 4th.	Cure.	2 years.
16	F.	26	...	Right.	No.	Fibroma of plantar fascia.	Removal of fibroma.	Cure.	12 months.
17	M.	32	4th.	Left.	Flat.	...	Excis. of head of metatarsal.	Cure.	9 years.

where a fibroma of the plantar fascia in the one case, and an old fracture with callosity in another, produced the symptoms of plantar neuralgia. In discussing the pathology later, I will draw attention to Tubby's views.

Dr Roswell Park refers to the case of a girl aged 20, but does not report it fully, nor does he give the result of treatment.

I have already referred to the views of Thomas G. Morton as to the causation of the pain,—views which are in part, if not wholly, shared by most of the subsequent writers. T. S. K. Morton thinks that the theory of his namesake accounts undoubtedly for the great majority of cases, and that perhaps all could be ascribed to pinching of the nerve between the metacarpo-phalangeal articulation; yet he urges that a few cases have been reported in which the transverse metatarsal ligament has appeared to be lax or ruptured, allowing of the metatarsal heads to descend upon the nerves. This is an explanation also preferred by Auguste Poullosson of Lyons, who believes that the laxity of the transverse metatarsal ligament allows of a pinching of the nerve between the heads of the metatarsals. He submitted only one case, and named the affection ‘anterior metatarsalgia.’

In the *Lancet* of March 19th, 1889, Dr. Guthrie wrote on “a form of painful toe” to which he was personally subject. It was brought on by standing or walking. He obtained relief by removing the boot and putting pressure along the line of the painful joints, and could recognise that the act caused a reduction of subluxation, a sharp twinge of pain accompanying the passage of the head of the metatarsal bone back into its normal position. He was especially liable to attacks of pain on hot, damp days, after walking for any length of time, but had learned to reduce the dislocation without taking off the boot by treading heavily on the toe of the affected foot with the heel of the other, and forcibly drawing the former backward within the boot, at the same time elevating the toes against the upper-leather. He effected a cure upon himself by removing the barrier to free action of the toes.

Grun—also a sufferer—believes that the descent of the tarsal arch is accountable for the malady; and that, as this is accom-

panied by a lengthening of the foot, which spreads mainly to the outer side, and as the foot will not yield in corresponding fashion, a frightful cramping pain is the result.

Tubby, whilst agreeing with Morton's explanation of plantar neuralgia over the 4th and 5th joints, advances another anatomical theory for those cases in which the pain starts between the 2nd and 3rd, and 3rd and 4th. He thinks, that when the transverse arch gives way at the heads of the metatarsal bones, and tight boots continue to be worn, the heads of the metatarsal bones are rubbed together, and painful pressure on the nerves ensues. One head is pushed out of place at the spot where pressure is greatest, and the nerve is compressed between the adjacent heads and the depressed one, and pain is most marked there. He specially draws attention to the existence of large corns over the painful spot, but he does not enter into their causal relationship with the neuralgia. He also believes that the affection frequently arises from osteo-arthritis.

Dr Goldthwaite of Boston, after examining many cases in which the symptoms were referred to the feet, and after experimenting with various lines of treatment, was convinced that the obliteration of the transverse arch was the direct cause of many of the symptoms, and that its restoration in these cases is of the same importance as is that of the longitudinal arch in flat-foot. With its obliteration the weight is received directly upon the middle of the foot, the outer and inner sides no longer furnishing their normal support, so that nearly all the impact comes upon the 2nd and 3rd toes. He thinks that if careful examination be made, in most cases of metatarsalgia these joints are more often affected than is the 4th. His conclusions are:—

“At the metatarso-phalangeal articulations there is an arch, called by the writer the ‘anterior transverse arch.’ This at times becomes flattened, and symptoms develop which are characteristic.

“The symptoms most commonly met with are pain, referred to the anterior portion of the foot—the so-called ‘anterior metatarsalgia’—and the presence of a painful callus in the centre of the ball of the foot.

“The impression of the foot is typical, and can be developed in many cases, even when the longitudinal arch also is obliterated.

“The treatment consists in the restoration of the arch by plates, pads, or bandaging.”

My reasons for dissenting from the theory of causation as advanced by Morton may be summarised as follows:—

1. The plantar digital nerves, instead of passing between the heads, lie on the transverse metatarsal ligaments, and when the foot is pressed upon, are pushed away from, not between, the bones (figs. 5 and 6).



FIG. 5.—Diagram showing the nerves generally trodden upon in Plantar Neuralgia.

2. It is not proved that the anatomical position of the heads of the 3rd, 4th, and 5th metatarsals is favourable to a nipping of the nerve on lateral pressure: on the contrary, there would be less escape were the metatarsal heads in absolute line.

3. That, in the majority of cases, a painful spot can be found and made intensely sensitive by pinching with the thumb on the dorsal and the forefinger on the plantar surfaces. That such spot is usually quite local, and would not respond to such pressure if, as asserted, the pinched and sensitive nerve were placed between the bones.

4. That, in most cases, a broadened foot, due to collapse of the anterior arch, accompanies the affection, rendering the digital nerves less liable to compression. This fact, in conjunction with another, viz., that a broad-soled boot hardly gives any relief in the 3rd degree of plantar neuralgia, is strongly at variance with Morton's theory.

5. That, in a large number of cases, grasping the foot round the metatarsal heads, thus approximating them, relieves the spasm.

6. That frequent flexing of the toes is an instinctive method of relieving spasm, the flexing of the toes being accompanied by slight approximation of metatarsal heads.



FIG. 6.—Plantar aspect of foot, showing the position of the digital nerves.

7. That manipulations of the foot by the surgeon, other than applying direct local pressure, rarely produces the pain.

I believe that clinical observations accord much better with a theory of *treading upon*, rather than with that of *pinching*, a nerve, and am fortified in this opinion by three anatomical facts:

(a) The proximity to the painful area of the communicating fourth branch of the superficial division of the external plantar.

(b) The collapse of the anterior arch in most of the cases.

(c) The bulk of superincumbent bodyweight in walking on the toes is borne on the 1st and 4th joints.

Tubby, in describing his cases, draws attention to the existence of corns over the painful area. In not one of my cases was

this noticeable. When corns are found, however, they simply denote pressure spots, and are situated over bony prominences. They point to pressure upon the nerve between the corn and articulation, and support the theory I advance in contradistinction to the nipping of nerve between bone. My cases of plantar neuralgia due to fibroma of the plantar fascia and fracture of the metatarsal bone equally support my contention. Gibney, in an interesting article in the *Journal of Nervous and Mental Diseases*, states that if the bases of the metatarsal bones were tightly grasped, the distal ends are separated, and the nerves are no longer compressed. My own experiments do not bear out the conclusion Gibney has recorded; and even were it otherwise, the majority of patients obtain relief not by compressing

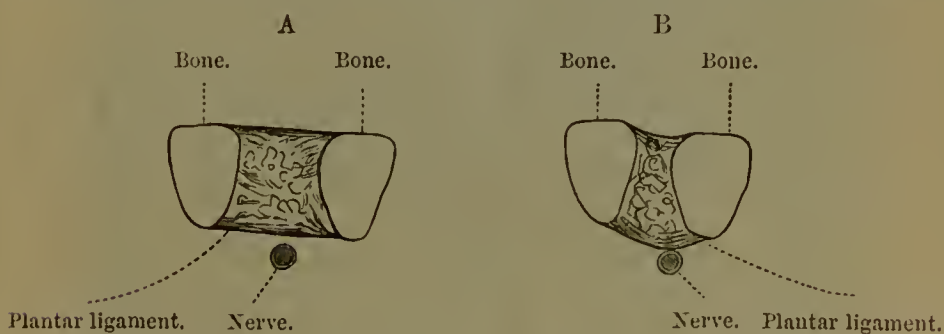


Diagram showing how compression of metatarsal heads fails to pinch the nerve between the bones. A, position of nerve when pressure is placed on foot. B, position of nerve when foot is compressed laterally by hand or foot.

the bases, but by compressing the heads, of the metatarsals. Fig. 4 is a diagrammatic sketch intended to show how compression of the metatarsals serves to press further from the bones the plantar digital nerves into a position where pressure from standing or walking might painfully act upon them.

If any normal foot be examined, one will find that the two prominent spots upon which most of the body pressure is borne are opposite the 1st and 4th metatarsal joints. The 5th is also prominent, but is so mobile that it can be easily pushed to one side. This is a strong reason, therefore, why the fourth metatarsal should most frequently supply the painful area. The 3rd and 4th become affected generally in cases of collapse of the anterior arch, where, instead of being concave on the

plantar aspects, the metatarsals present a convexity, the second and third articulations forming the most prominent portion of the convexity.

From the persistence of pain in certain cases, even after pressure has been withdrawn, and from the immediate sensitiveness when walking is practised, one is inclined to believe that



FIG. 8.—Flat foot, with no weight placed upon it.

a neuritis of the plantar nerves involved exists in the more acute cases. This view is confirmed by the fact that, even after a long rest, pinching the spot between finger and thumb gives rise to severe pain.

Dr Holland has taken three radiographs for me, in order to prove the existence of wide spaces between metatarsal heads during walking. Fig. 8 represents a foot without weight being

applied. Fig. 9 is taken while the patient placed full weight upon it. Fig. 10 represents the same foot in a boot, and the radiograph was taken while the patient stood. The foot was a typically flat one, with a yielding anterior arch; and the photographs are suggestive of the difficulty of the plantar nerves being pinched between the bones.



FIG. 9.—Flat foot, full weight being placed on foot.

Treatment.—The treatment of plantar neuralgia must vary with the stage of the affection. In the first stage the patient will do well to take the warning given, and by appropriate precautions prevent the development of the affection. This is done by attention to certain details:—

(a) To abstain from continuing any action which produces the pain.

(b) To increase the depth of the inner aspect of heel, in order to produce slight inversion of foot.

(c) To wear thick soles, with well-fitting insteps, and roomy around the heads of the metatarsals.

(d) *To insist that the sole be at least one-fourth of an inch thicker a little behind the bases of the metatarsals.*



FIG. 10.—Same foot as fig. 8, confined in boot and weight applied. Showing space between the metatarsals during walking.

The preventive methods as applied in the first stage should also be directed to the cure of the second stage, with certain additions.

These additions may be any or all of the following measures :—

(a) A thick bar placed about half an inch behind the metatarsal heads (fig. 7).

(b) A band of non-irritating plaister around the instep.

(c) Massage of foot, with contrast baths of hot and cold water.

(d) Elevation of the foot of the bed at night-time.

The advantage of thick-soled boots is obvious: they prevent excessive mobility at the articulation, and minimise sharp bony pressure upon the nerves. The boots should be roomy at the toes, not merely to give more room to the metatarsal heads, but to allow freedom to flex the toes, and to perform other movements to avoid pain. The heel of the boot is slanted to correct the common tendency to valgus and to vary the pressure point. In a case where there is no collapse of the arch the heel may with advantage be elevated on the *outer* side to deviate body pressure.



FIG. 7.—
Bar under
boot placed
too much
forward.

Most important of all, however, is the thickening of the sole in the early cases (or bar in later) of the sole behind the metatarsal heads. This gives rest to the articulation, even during the act of walking, and is of more advantage than any other mechanical detail of treatment. This alteration, even in the case of inflamed or gouty toe-joint, allows the patient to travel in comparative comfort, and should always be prescribed in all the stages of plantar neuralgia,—for a time even in those cases where an operation has been performed.

In the third stage of the affection nothing short of an operation is satisfactory. By this I do not mean that on no occasion can an advanced case be relieved by mechanical measures. On the contrary, it can, and often is. But operative measures are so safe and simple, and other measures so prolonged and troublesome, that most patients do not hesitate which course to accept. Of operations, only three are radical and efficient:—

(a) Exsection of metatarsal head.

(b) Excision of joint.

(c) Amputation of metatarsal head and toe.

Short of these radical measures, we may employ any or all of the following measures :—

- (1) Actual cautery.
- (2) Heated needle into painful site, to destroy nerve.
- (3) Hypodermic injections of carbolic acid.
- (4) Part exsection of digital plantar nerve.

It will be noted that each of these surgical practices involve the plantar or walking aspect of the foot,—a fact which seriously modifies its utility.

Of the radical operations, I would strongly advocate the superiority of exsection over incision and amputation. It is simple, safe, and sure, and can be performed in the following way :—

After the part has been carefully asepticated, an incision should be made a little over an inch in length, starting above the metatarso-phalangeal joint, and extending over the middle line of the toe. The extensor tendon is divided, the capsule opened, and the head of the metatarsal dissected out by a blunt instrument. With fine bone nippers the head is removed and the flexor tendon below divided. The wound is then stitched, and, as a rule, no vessels need securing. The after-treatment consists in keeping the patient in bed for about ten days, with the foot elevated. Massage should then be commenced, and the patient, with a bar under the boot, allowed to walk. There is usually nothing to hinder complete recovery in from five to six weeks, when boots such as I have earlier described should be prescribed.

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